55.

$$W = PV + \frac{V\delta v^2}{2g} = a + \frac{b}{g} \qquad a, b \text{ const}$$

$$dW = -\frac{b}{g^2} \cdot dg$$

$$\frac{dW_{moon}}{dW_{earth}} = \frac{-\frac{b}{5.2^2}\,dg}{-\frac{b}{32^2}\,dg} = \frac{32^2}{5.2^2} = 37.87$$

Nov 3-9:02 AM

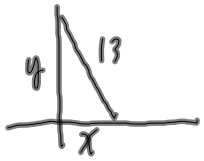
4.6 related rates (related derivatives) w.r.t. time

2 related variables change over time.

given: how fast 1 variable changes

find: how fast the other variable changes

ex.



13 ft ladder leans against a wall. the bottom pulls away at a constant rate of 2 ft/sec. How fast does the top fall?

given $\frac{dx}{dt} = 2 \frac{ft}{sec}$

how are x & y related $x^2 + y^2 = 13^2$ take der wrt t

find $\frac{dy}{dt}$ $2x\frac{dx}{dt} + 2y\frac{dy}{dt} = 0$

grows with time → $\frac{dy}{dt} = -\frac{x \cdot 2}{y}$ y gets smaller x gets bigger

Nov 3-9:28 AM

How fast is the top of the ladder falling when the bottom is 4 ft from the wall?

$x = 4$

$y = \sqrt{13^2 - 4^2}$

$\frac{dy}{dt} = -\frac{2x}{y}$

$= \frac{-2 \cdot 4}{\sqrt{13^2 - 4^2}} = -.6468$ ~~ft~~ sec

neg means y is decreasing.

Nov 3-9:43 AM

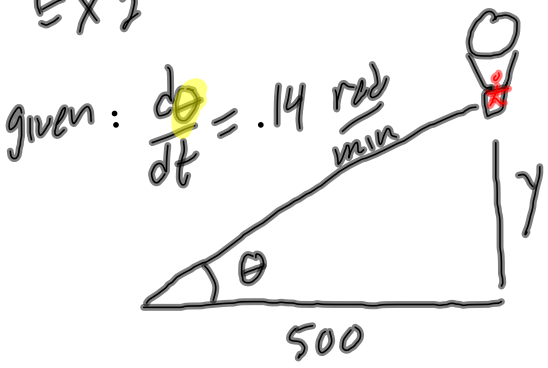
strategy for related rates problems

p 246, 247

1. understand the problem
   what variables? what constants
   what rates are given
   what rate should you find
2. Model - pic, variables
3. ——— equation(s)
4. take der wrt t
5. sub & solve for der

Nov 3-9:47 AM

Ex 2



given: $\frac{d\theta}{dt} = .14 \frac{rad}{min}$

find $\frac{dy}{dt}$

(how fast is it rising)

$\tan\theta = \frac{y}{500}$

$y = 500\tan\theta$

now we can plug in $\theta = \frac{\pi}{4}$

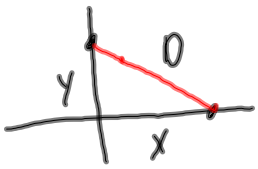
$\frac{dy}{dt} = 500 \cdot \sec^2\theta \cdot \frac{d\theta}{dt}$

$= 500 \sec^2\frac{\pi}{4} \cdot (.14)\frac{d\theta}{dt}$

$= 500 \cdot 2\,(.14) = 140 \frac{ft}{min}$

Nov 3-9:51 AM

Ex 3



put in variables for things that change over time

given $\frac{dO}{dt} = 20$

$\frac{dy}{dt} = 60$

find $\frac{dx}{dt}$ when $x = 8$, $y = 6$

$O^2 = x^2 + y^2$

$2O\frac{dO}{dt} = 2x\frac{dx}{dt} + 2y\frac{dy}{dt}$

$2\sqrt{8^2+6^2} \cdot 20 = 2(8)\frac{dx}{dt} + 2(6)60$

$\frac{dx}{dt} = \frac{2\sqrt{8^2+6^2} \cdot 20 - 2(6)60}{2(8)}$

$= 70$ mph

Nov 3-10:04 AM